EUROPEAN COMMISSION
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CLIMATE ACTION
Directorate B - European & International Carbon Markets

Guidance Document n°8
on the harmonized free allocation methodology for the EU-ETS
post 2012

Waste gases and process emissions sub-installation

Final version issued on 14 April 2011

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1 Introduction

1.1 Status of the Guidance Documents

This guidance document is part of a group of documents, which are intended to support the Member States, and their Competent Authorities, in the coherent implementation throughout the Union of the new allocation methodology for Phase III of the EU ETS (post 2012) established by the Decision of the Commission [Date of adoption and OJ reference to be added when available] on "Transitional community-wide and fully harmonised implementing measures pursuant to Article 10a(1) of the EU ETS Directive" (CIMs) and developing the National Implementation Measures (NIMs).

The guidance does not represent an official position of the Commission and is not legally binding.

This guidance document is based on a draft provided by a consortium of consultants (Ecofys NL, Fraunhofer ISI, Entec). It takes into account the discussions within several meetings of the informal Technical Working Group on Benchmarking under the WGIII of the Climate Change Committee (CCC), as well as written comments received from stakeholders and experts from Member States. It was agreed that this guidance document reflects the opinion of the Climate Change Committee, at its meeting on 14 April 2011.

The guidance papers do *not* go into detail regarding the procedures that Member States apply when issuing greenhouse gas emissions permits. It is acknowledged that the approach to setting the installation boundaries laid down in GHG emissions permits differ between Member States.

1.2 Background of the CIM Guidance Documents

Specific topics were identified within the CIMs which deserve further explanation or guidance. The CIM guidance documents intend to address these issues as specific and clear as possible. The Commission considers it necessary to achieve the maximum level of harmonisation in the application of the allocation methodology for phase III.

The CIM guidance documents aim at achieving consistency in the interpretation of the CIMs, to promote harmonisation and prevent possible abuse or distortions of competition within the Community. The full list of those documents is outlined below: In particular:

- Guidance document n. 1 – general guidance: this guidance gives a general overview of the allocation process and explains the basics of the allocation methodology.
- Guidance document n. 2 – guidance on allocation methodologies: this guidance explains how the allocation methodology works and its main features.

- Guidance document n. 3 – data collection guidance: this guidance explains which data are needed from operators to be submitted to the Competent Authorities and how to collect them. It reflects the structure of the data collection template provided by the EC.
- Guidance document n. 4 – guidance on NIMs data verification: this guidance explains the verification process concerning the data collection for the National Implementation Measures[1].
- Guidance document n. 5 – guidance on carbon leakage: it presents the carbon leakage issue and how it affects the free allocation calculation.
- Guidance document n. 6 – guidance on cross boundary heat flows: it explains how the allocation methodologies work in case of heat transfer across the 'boundaries' of an installation.
- Guidance document n. 7 – guidance on new entrants and closures: this guidance is meant to explain allocation rules concerning new entrants as well as the treatment of closures.
- Guidance document n. 8 – guidance on waste gas and process emission sub-installation: this document provides for explanation of the allocation methodology concerning process emission sub-installation, in particular, concerning the waste gas treatment.
- Guidance document n. 9 – sector specific guidance: this guidance provides for detailed description of the product benchmarks as well as the system boundaries of each of the product benchmarks listed within the CIMs.

This list of documents is intended to complement other guidance papers issued by the European Commission related to Phase III of EU ETS, in particular:
- Guidance on Interpretation of Annex I of the EU ETS Directive (excl. aviation activities), and
- Guidance paper to identify electricity generators

References to Articles within this document generally refer to the revised EU ETS Directive and to the CIMs.

1.3   Use of the Guidance documents

The guidance documents give guidance on implementing the new allocation methodology for Phase III of the EU ETS, as from 2013: the Member States may use this guidance when they perform the data collection pursuant to Article 7 of the CIMs in order to define the complete list of installations as well as to calculate any free allocation to be determined for the National Implementing Measures (NIMs) pursuant to Article 11(1) of the Directive 2003/87/EC.

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[1] Article 11 of Directive 2003/87/EC

1.4 Additional guidance

Next to the guidance documents, additional support to the Member State authorities is provided in the form of a telephone helpdesk, and the EC-website, with list of guidance documents, FAQs and useful references, http://ec.europa.eu/clima/policies/ets/benchmarking_en.htm .

1.5 Scope of this guidance document

The objective of this document is to provide guidance to Competent Authorities (CA) on how to allocate free allowances to installations which produce and consume waste gases and more in general on the allocation according to the process emissions sub-installation.

Chapters 2 of this document present the definitions of waste gases and the process emissions sub-installation. Subsequently, Chapter 3 provides some background to the occurrence of waste gases in industry. Chapter 4 discusses the allocation in case of production and consumption of waste gases. Chapter 5 illustrates these rules with a few case studies.

Definitions and allocation rules in this Guidance Document are based on the CIMs Waste gas-related issues are discussed in the following recitals of the CIMs decision:
- 1, 8 (which both state that the ETS should set incentives for the efficient energy recovery from waste gases)
- 11 (notes on the benchmark values for coke, hot metal and sinter where waste gases are involved in large amounts)
- 31 (no allocation to electricity generation with the exception of allocation for the modernisation of electricity generation and electricity from waste gases)
- 32 (which refers to the most relevant case in terms of emission amounts of when waste gases occur with a benchmarked product)
- 33 (which refers to flared waste gases and the particular case of safety flaring).

Further relevant are the definitions in:
- Art. 3(h) on process emissions (as well as all other articles relevant for process emissions)
- Art. 3(p) on safety flaring.

2   Definitions

Waste gases

Waste gases are generally defined as gases which emerge from incomplete combustion or other chemical reaction in an EU-ETS installation and which comply with all of the following criteria[2]:

- Waste gases are not emitted without further combustion due to a significant content of incompletely oxidised carbon
- The calorific value of waste gases is high enough for the waste gas to burn without auxiliary fuel input, or to contribute significantly to the total energy input when mixed with fuels of higher calorific value
- The waste gas is produced as by-product of a production process.

Carbon reacts with oxygen according to the following chemical equations:
$C + O_2 \rightarrow CO_2$ (completely oxidised)
$2 C + O_2 \rightarrow 2 CO$ (incompletely oxidised)
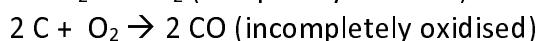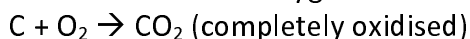
Incompletely oxidised carbon may also consist of partial oxidised organic products according following (simplified) reaction:
$C_xH_y + zO_2 \rightarrow CO_2 + CO + C + C_mH_nO_o + H_2 + H_2O$
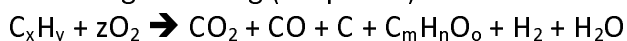
Waste gases are usually a mix of different gases including CO_2 which are transferred from the originating process to other processes. Within these mixes, the CO_2 content is treated as part of the waste gas stream. The higher the share of non- and incompletely oxidized carbon in fuels, the higher the calorific value. The calorific value of completely oxidised carbon (CO_2) is zero.

Process emission sub-installation

The process emissions sub-installation is defined in Art. 3(h) of the CIMs:
'Process emissions sub-installation' means greenhouse gas emissions listed in Annex I of Directive 2003/87/EC other than carbon dioxide, which occur outside the system boundaries of a product benchmark listed in Annex I, or carbon dioxide emissions, which occur outside the system boundaries of a product benchmark listed in Annex I, as a result of any of the following activities and emissions stemming from the combustion of incompletely oxidised carbon produced as a result of the following activities for the purpose of the production of measurable heat, non-measurable heat or electricity provided that emissions that would have occurred from the combustion of an amount of natural gas, equivalent to the technically usable energy content of the combusted incompletely oxidised carbon, are subtracted:

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[2] Discussion paper – Allocation rules; Environment Agency Austria; 2010

(i)   the chemical or electrolytic reduction of metal compounds in ores, concentrates and secondary materials;

(ii) the removal of impurities from metals and metal compounds; (iii) the decomposition of carbonates, excluding those for flue gas scrubbing;

(iv) chemical syntheses where the carbon bearing material participates in the reaction, for a primary purpose other than the generation of heat;

(v)   the use of carbon containing additives or raw materials for a primary purpose other than the generation of heat;

(vi) the chemical or electrolytic reduction of metalloid oxides or non-metal oxides such as silicon oxides and phosphates;

In other words, the process emissions sub-installation can be any of the following, when the emissions occur within an ETS installations, but outside the boundaries of a product benchmark:

a) non-CO_2 greenhouse gas emissions (i.e. N_2O for specific sectors; see Annex I of Directive 2009/29/EC for the list of activities for which N_2O emissions are included in the EU-ETS for phase 3)

b) CO_2 emissions from any of the activities listed in this definition [(i) to (vi)]

c) Emissions from the combustion of incompletely oxidised carbon such as CO emitted by any of these activities [(i) to (vi)], if it is combusted to produce heat or electricity. Only emissions which are **additional** to the emissions that would occur if natural gas was used are taken into account. In calculating the additional emissions the "technically usable energy content" should be considered. Compared to other fuels, most waste gases have a higher emission intensity and can therefore be used less efficient compared to other fuels. A correction therefore needs to be applied for the difference in efficiencies between the use of waste gas and the use of a reference fuel.

For the allocation of process emissions type a and b under the process emission sub-installation, reference is made to Guidance Document 2. For process emissions type b and c under the process emission sub-installation, only activities [(i) to (vi)] carried out within the scope of the ETS can be considered.

Process emissions of type b only cover CO_2 as direct and immediate result of the production process or chemical reaction and as directly released to the atmosphere. CO_2 from the oxidation of CO or other incompletely oxidized carbon is not covered by type b regardless if this oxidation takes place in the same or a separate technical unit (but it would be covered by type c in case of energy recovery).

Example: In an open furnace without energy recovery, a chemical reduction process leads to the production of a mix of CO and CO_2. At the presence of air, the CO is further oxidised to CO_2 and as result, 100% CO_2 is released to the atmosphere. The CO_2 from the oxidation of CO cannot be regarded as process emission type b, since only the CO_2 as *direct result of activities i to vi (see above)* can be considered as process emission of type b) and as CO_2 from the oxidation of CO is covered by type c (in case of energy

recovery). However, the part of the CO_2 which has been directly and immediately created (not by the combustion of CO) should be regarded as process emission of type b and therefore be eligible for free allocation. In case no historical data from measurements in accordance with applicable European standards of the shares of incompletely oxidized carbon (e.g. CO) and CO_2 covering the entire relevant baseline period are available, a default value for the share of CO_2 should be applied (see section 3.4 of Guidance Document 2).

The third type of process emissions c refers to waste gases. CO_2 as part of a gas mix including incompletely oxidized carbon which is not directly released to the atmosphere should be treated as part of the waste gas (and not as type b process emission). Only gas mixes containing more than a negligible amount of incompletely oxidized carbon can be regarded as waste gases in the context of the definition of the process emissions sub-installation. This criterion should be considered fulfilled if either the calorific value of the gas mix is high enough for the gas mix to burn without auxiliary fuel input, or to contribute significantly to the total energy input when mixed with fuels of higher calorific value.

Allocation for waste gas emissions will only take place if the waste gases are efficiently used for the production of measurable heat, non-measurable heat or electricity. Combustion of waste gas (CO to CO_2) in the open furnace is regarded as equal to flaring (if the energy from the combustion is not used for energy recovery). See chapter 4 of this Guidance Document for further details on the calculation of the allocation.

Figure 2-1 summarised the three types of process emissions sub-installations.
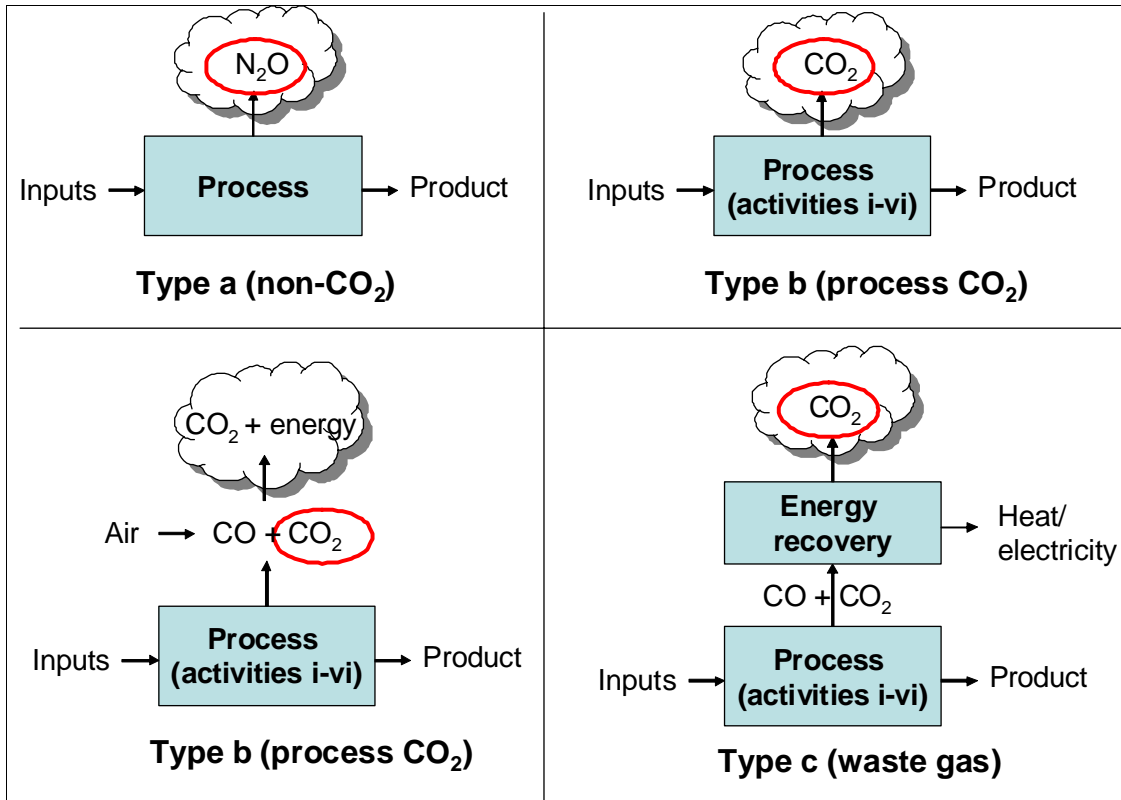
Figure 2-1   Overview of process emissions sub-installations (the emissions covered by the sub-installations are marked by the red ellipses)

Waste gases produced within the boundaries of a product benchmark

In the case of benchmarked products, the emissions related to the production of waste gases (and to their consumption if the waste gas is consumed within the boundaries of a relevant benchmark) are included in the boundaries and the value of the relevant benchmark. The same holds for process emissions (e.g. in the production of cement clinker) occurring within the system boundaries of a product benchmark.

Flaring and safety flaring

Further relevant for the free allocation of allowances to waste gases are the issues of flaring and safety flaring. Safety flaring is defined in Art. 3(p) as

"the combustion of pilot fuels and highly fluctuating amounts of process or residual gases in a unit open to atmospheric disturbances which is explicitly required for safety reasons by relevant permits for the installation".

In other words, flaring can be considered as safety flaring if *all* three following conditions are met:

1. The flaring is required by relevant permit for safety reasons *AND*
2. The combustion takes place in a unit open to atmospheric disturbances (the combustion in other units is not covered) *AND*
3. The amounts of process or residual gases are highly fluctuating.

The third requirement can be regarded as fulfilled if the flare does not operate continuously. Examples of flares that are not continuous are intermittent flares for either planned or unplanned activities such as maintenance and tests or unplanned events such as emergency situations. Continuously operating flares can be regarded to fulfill the third requirement if it can demonstrated that the combusted amounts of residual gases are highly fluctuating on a day to day basis, i.e. that the residual gases are not produced in standard quantities resulting under normal operation. For this purpose the flared amounts over the entire baseline period should be considered and statistically analysed.

Please note that requirements in a permit are not sufficient to qualify a flare as safety flare as in particular the criterion of high fluctuation needs to be met.

Safety flaring does not necessarily require that the residual gases flared are regarded as waste gases.

The emissions related to flaring include:

a. Emissions from the combusted flared gas
b. Emissions from the combustion of fuels necessary to operate a flare, which are of two types:
    i. The fuels necessary to keep a pilot flame running
    ii. The fuels required to successfully combust the flared gas.

In case of safety flaring of gases not resulting from processes covered by product benchmarks, the combusted flared gas and the fuels necessary to operate the flare are eligible for free allocation, based on the fuel benchmark allocation methodology.

In case of other types of flaring, emissions from both origins are not eligible for free allocation.

3 Background to waste gases in specific industries

Waste gases accrue e.g. in the iron and steel industry and the chemical industry.
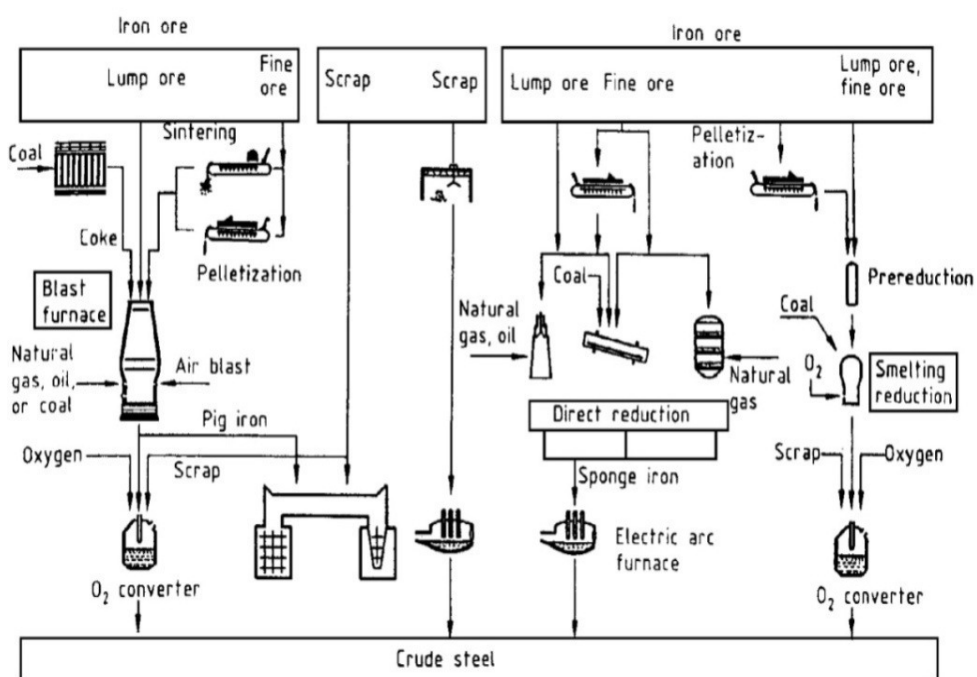
3.1 Iron and Steel and other metals industry

Figure 3-1   **Crude steel production [Ullmann 1994][3]**

In the iron and steel industry waste gas arises in the coke oven, the blast furnace and the basic oxygen furnace and are then often transferred to other installations (EU-ETS or non-ETS installations) to be recovered. CO_2-emissions from these waste gases occur therefore there.

- Coke making results in coke oven gas (COG), (emission factor: 44.7 tCO_2/TJ, calorific value: 38.7 TJ/Gg)[4] which has a lower emission intensity than natural gas (NG) (56.1 tCO_2/TJ, 48 TJ/Gg). In stand-alone coke oven plants, coke oven gas is used for the under-firing of coke oven batteries.
- Different to this, in integrated steel plants with an on-site coke oven plant, also blast furnace gas (BFG) is used for the under-firing (259.4 tCO_2/TJ, 2.5 TJ/Gg). This low-calorific gas – although usually considered as a fuel of very low value – is suitable for this purpose as it burns slowly and allows a more even

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[3] Ullmann's Encyclopedia of Industrial Chemistry; Wiley-VCH; 1994
[4] Emission factors and calorific values from EU Decision 2007/589/EC

distribution of heat across the walls of the coke oven chambers. In integrated steel works, blast furnace gas is used for many upstream processes (like coke making) and downstream processes (rolling) as well as for electricity production, which may also be outsourced. These processes however are also applied in stand-alone configurations and there have to rely on alternative fuels like natural gas.

- Basic oxygen furnace gas (BOFG) is – as the name implies – produced in the basic oxygen furnace. Regarding the emission factor and the calorific value it is between COG and BFG (171.8 tCO_2/TJ, 7.1 TJ/Gg). It can be used for both up- and downstream processes.

In addition, waste gases can be formed in high temperature reduction processes to produce metal alloys.

3.2 Chemical industry

In the chemical industry waste gases are formed in chemical reactions such as partial oxidisation, ammonium oxidisation and hydroformylation used for the production of products such as carbon black, acetylene, olefins and synthesis gas. Also in the reduction of pure sand to silicon carbide using a carbon source, waste gases are formed. To give an example, the tail gas from the carbon black process consists of 30-50% water vapour, 30-50% nitrogen, 1-5% CO_2 and small amounts of CO and H_2. This low calorific mixture enables energy recovery by producing steam, hot water or electricity.

4   Allocation

The allocation related to waste gases is split into two parts, which can be treated by different types of sub-installations:

- Allocation related to the production of waste gases (Section 4.1)
- Allocation related to the consumption of waste gases (covered in Section 4.2)

One important element to keep in mind (further detailed here-after) is that the allocation relating to the production of the waste gas will be allocated:

- to the **producer** of the waste gas in case a waste gas is produced within the boundaries of a product benchmark
- to the **consumer** of the waste gas in the case of a waste gas produced outside the boundaries of a product benchmark.

Allocation related to the consumption of the waste gas will always be allocated to the **consumer** of the waste gas.

In many cases however, the waste gases will be consumed on-site, and therefore the consumer and the producer will be the same installation.

To further clarify this approach, Section 4.3 describes the total allocation in case of waste gas production inside and outside the boundaries of a product benchmark. To provide an easy to use reference, Section 4.4 gives a complete summary of allocation methods to be used in case of waste gas production and consumption.

4.1   Allocation relating to the production of the waste gas

For the allocation related to the production of waste gases, only emissions additional to emissions that would come from the combustion of the reference fuel natural gas are accounted for. The remaining emissions can, depending on the use of the waste gas, be allocated based on an allocation methodology relevant for the waste gas consumption (see section 4.2).

Waste gases produced within the boundaries of a product benchmark

If the waste gas is produced within the boundaries of a benchmarked product, the product benchmark includes the allocation relating to the production of the waste gas and the allocation related to safety flaring (see Figure 4-1). Hence, allocation for the production of the waste gas is granted to the producer of the waste gas.

The consumer of the waste gas receives no additional allocation for the production of the waste gas. The consumer can however receive allocation for the consumption of the waste gas (see section 4.2).

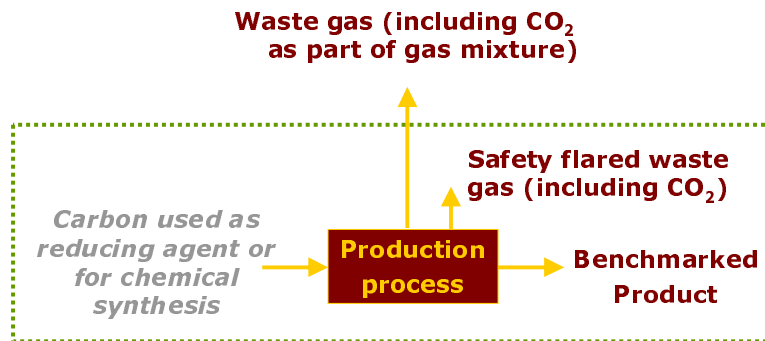Note that producer and consumer can be the same installation.

Waste gas (including CO_2 as part of gas mixture)

Safety flared waste gas (including CO_2)

Carbon used as reducing agent or for chemical synthesis

Production process

Benchmarked Product

Figure 4-1   Emission of waste gases within the boundaries of a product benchmark

Waste gases produced outside the boundaries of a product benchmark
If the waste gas is produced outside the boundaries of a product benchmark, and if this waste gas is not ultimately flared, a fall-back approach is applied (see Figure 4-2). The emissions relating to the <u>production</u> of waste gas that are used for the production of measurable heat, non-measurable heat or electricity will be regarded as a <u>process emissions sub-installation.</u> Emissions from waste gases that are flared are not considered as process emissions sub-installation and will not be eligible for free allocation, except in the case of safety flaring, where allocation will be made based on the fuel benchmark *(see chapter 2 for a discussion on the definition of safety flaring)*.
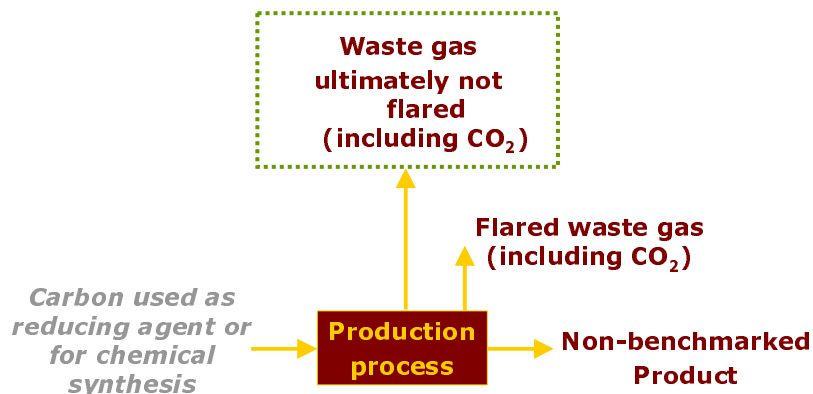
Waste gas ultimately not flared (including CO_2)

Flared waste gas (including CO_2)

Carbon used as reducing agent or for chemical synthesis

Production process

Non-benchmarked Product

Figure 4-2   Emission of waste gases outside the boundaries of a product benchmark. The green dashed line shows the boundaries of a process emissions sub-installation

As the emissions related to waste gas occur when the waste gas is combusted, the allocation will be given to the <u>consumer</u> of the waste gas. The free allocation is obtained by multiplying the historical activity level ($HAL_{WasteGas}$) with a factor 0.97.

$$Allocation = HAL_{WasteGas} \; x \; 0.97 \qquad (1)$$

The historical activity level of this sub-installation is determined as follows:

$$HAL_{WasteGas} = Median_{BaselinePeriod} \; [V_{WG} \; x \; NCV_{WG} \; x \; (EF_{WG} - EF_{NG} \; x \; Correction_{\eta})] \quad (2)$$

where

$HAL_{WasteGas}$	is the Historical Activity Level of the sub-installation related to the production of waste gases not covered by a product benchmark (expressed in tCO_2e)
V_{WG}	is the volume of waste gas that is not flared (expressed in Nm^3 or tonnes)
NCV_{WG}	is the Net Calorific Value of the waste gas (expressed in TJ/Nm^3 or TJ/t)
EF_{WG}	is the emission factor of the waste gas (expressed in tCO_2/TJ)
EF_{NG}	is the emission factor of natural gas ($56.1 \; tCO_2/TJ$)
$Correction_{\eta}$	is a factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel natural gas, the default value of this factor is equal to 0.667.

Alternatively, the historical activity level could be determined by the methodology used for type b process emissions sub-installations (see guidance document 2 on allocation methodologies, section 3.4).

In case the emission factor of the waste gas is lower than the emission factor of natural gas times the correction, $HAL_{WasteGas}$ should be considered being zero.

The content of CO_2 in the waste gas is treated as part of the waste gas stream. Therefore, the values for the volume, the Net Calorific Value and the emission factor of the waste gas are referring to the total waste gas stream including CO_2.[5]

A default correction factor ($Correction_{\eta}$) of 0.667 should be used unless the operator can provide acceptable data proving that a different factor should be used. Different factors should only be used if the uses of waste gas and efficiencies related to these uses are known.

4.2 Allocation relating to the consumption of the waste gas

Regardless of the composition of the waste gas and of its origin, the *use* of a waste gas is treated as any other fuel:
- When it is used to produce electricity or when it is flared, there will be no allocation for this action (except in the case of safety flaring of waste gases

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[5] The same approach has been applied to waste gases covered by product benchmarks.

produced outside the boundaries of a product benchmark. In that case allocation will occur using the fuel benchmark).

- When it is used in the production of a benchmarked product, the allocation is taken into account in the benchmark of this product
- When it is used to produce measurable heat, the consumption of this heat will be allocated based on the heat benchmark (if heat consumption not already covered by a product benchmark)
- When it is used as a combustion fuel for the production of non-measurable heat and not used for electricity production, the sub-installation consuming this fuel will receive an allocation based on the fuel benchmark
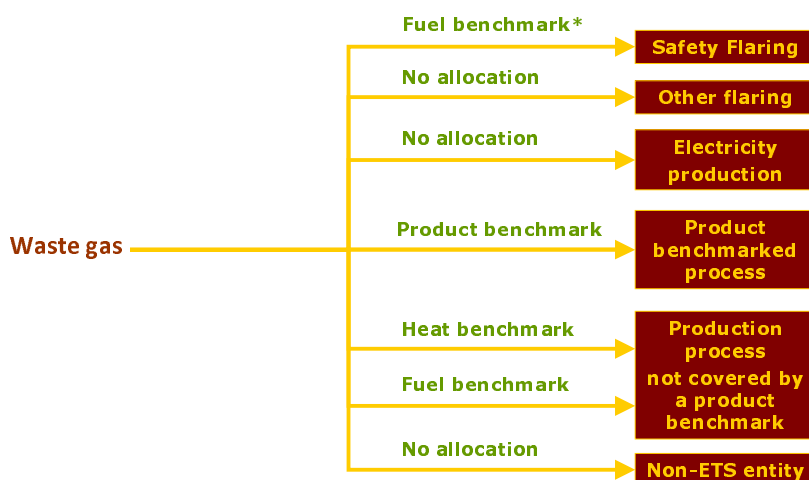

Figure 4-3   Allocation for the consumption of waste gases; *Safety flaring only receives allocation based on a fuel benchmark in case the flared waste gas is produced outside the boundaries of a product benchmark

4.3   Total allocation for production and consumption of waste gases

Waste gases produced within the boundaries of a product benchmark

Figure 4-4 gives an overview of allocation methodologies to be used in case of production of waste gases inside the boundaries of a product benchmark:

- **The allocation for waste gas production** is taken into account by the product benchmark. This allocation goes to the producer of the waste gas.

- **The allocation for waste gas use** (if applicable) goes to the user of the waste gas. Figure 4-4 shows which allocation methodology should be used for different types of consumers.

In many cases, the waste gases will be consumed on-site, and therefore the consumer and the producer will be the same installation.
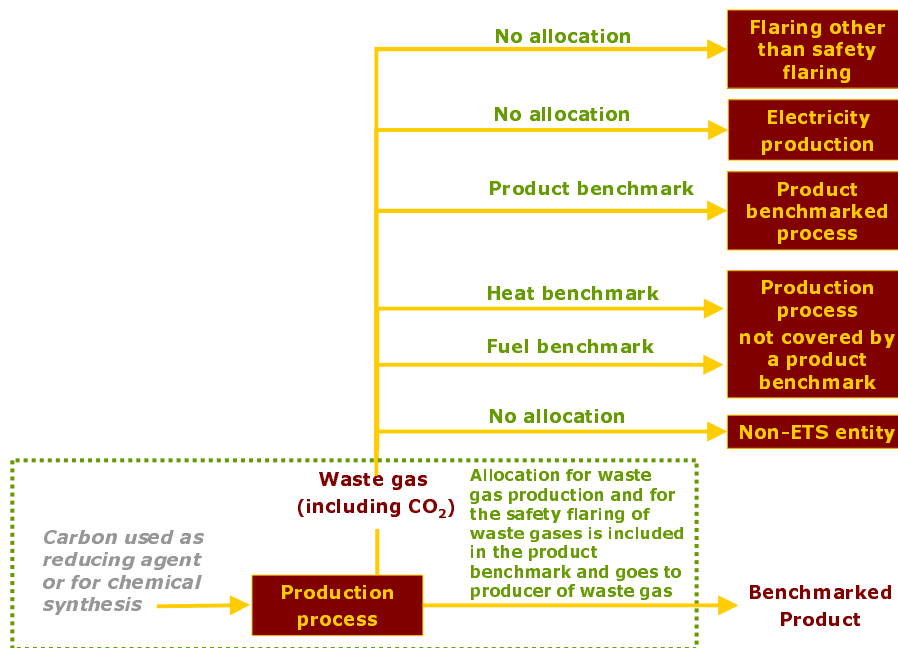
Figure 4-4 Overview of allocation in case of production of waste gases within the boundaries of a product benchmark

Waste gases produced outside the boundaries of a product benchmark

Figure 4-5 gives an overview of allocation methodologies to be used in case of production of waste gases outside the boundaries of a product benchmark:

- **The allocation for the production of waste gases that are ultimately not flared** is based on the approach for the process emission sub-installation (see equation 1; section 4.1). This allocation goes to the user of the waste gas. If the waste gas is used by more than one ETS installation, the allocation is distributed over these installations based on the amounts of waste gases used by the different ETS installations.

- **The allocation for waste gas use** (if applicable) goes to the user of the waste gas. Figure 4-5 shows which allocation methodology should be used for different types of consumers.

In many cases, the waste gases will be consumed on-site, and therefore the consumer and the producer will be the same installation.
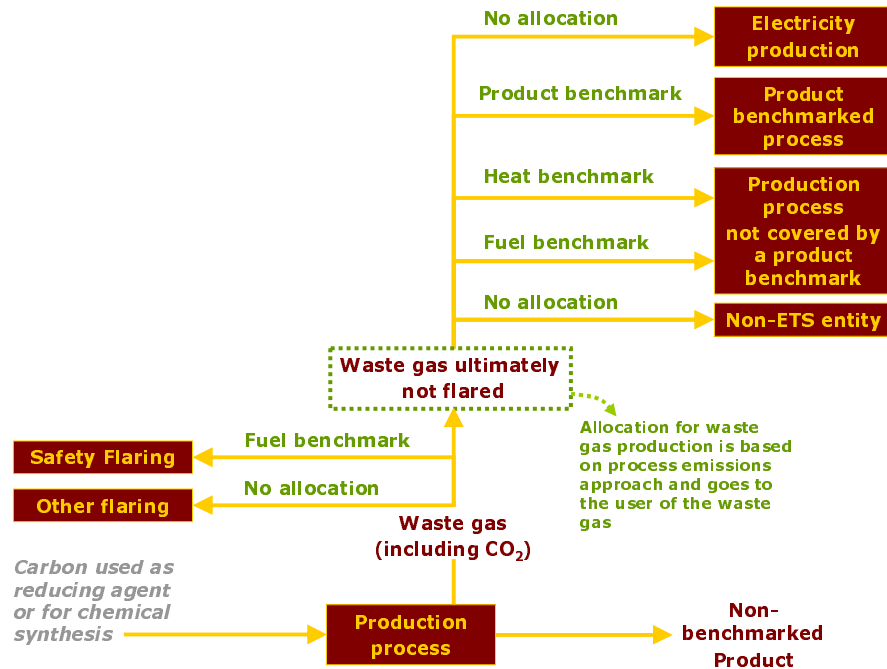
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Figure 4-5 Overview of allocation in case of production of waste gases outside the boundaries of a product benchmark. The green dashed line indicates the boundaries of a process emissions sub-installation

Care must be taken that no allocation is given twice relating to the same carbon content: once for the waste gas via the process emission sub-installation, and once via a fuel benchmark sub-installation:

- Fuel used as reducing agent or for chemical syntheses should not be considered as fuel input into a fuel benchmark sub-installation.
- Any fuel which will ultimately end up in the waste gases should not be allocated via a fuel benchmark sub-installation.

To avoid double counting, the Historical Activity Level of the fuel benchmark sub-installation covering the fuel input to the production process causing the waste gases (see below-left in Figure 4-5) should be determined as follows:

$$HAL_{fuel} \quad = \quad Median_{baseline}[Fuel_{Process} - V_{WG} \; x \; NCV_{WG} \; x \; \alpha \;] \qquad\qquad (3)$$

where

HAL_{fuel} is the Historical Activity Level of the fuel sub-installation

$Median_{Baseline}$ is the median value over the baseline period

$Fuel_{process}$ is the total amount of fuel consumed in the production process excluding fuel used as reducing agent or chemical syntheses (expressed in TJ)

V_{WG} is the total volume of waste gas exiting the production process(expressed in Nm^3 or tonnes)

NCV_{WG} is the Net Calorific Value of the waste gas (expressed in TJ/Nm3 or TJ/t)

α is the share of waste gases originating from the fuel

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The Historical Activity Level of the fuel benchmark sub-installation covering safety flaring (see left in Figure 4-5) should be determined as follows:

$$HAL_{fuel} = Median_{baseline}[Fuel_{SafetyFlaring} + V_{WG} \times NCV_{WG} \times \beta] \qquad (4)$$

where
HAL_{fuel} is the Historical Activity Level of the fuel sub-installation
$Median_{Baseline}$ is the median value over the baseline period
$Fuel_{SafetyFlaring}$ is the total amount of fuel necessary for safety flaring; i.e. the fuels necessary to keep a pilot flame running and fuels required to successfully combusted the flared gas (expressed in TJ)
V_{WG} is the total volume of waste gas exiting the production process (expressed in Nm^3 or tonnes)
NCV_{WG} is the Net Calorific Value of the waste gas (expressed in TJ/Nm3 or TJ/t)
β is the share of total waste gases that is flared for safety reasons

Note that safety flaring and the fuel input to the production process could be covered by the same fuel benchmark sub-installation. In that case, the historical activity level would be:

$$HAL_{fuel} = Median_{baseline}[Fuel_{Process} - V_{WG} \times NCV_{WG} \times \alpha + Fuel_{SafetyFlaring} + V_{WG} \times NCV_{WG} \times \beta]$$

4.4   Summary of allocation methodologies in case of waste gases

The following table summarises the allocation for the production of waste gases within or outside the system boundaries of a product benchmark and the various types of waste gas consumption.

Table 1.   Summary of allocation approaches for waste gases produced and consumption within or outside the boundaries of a product benchmark (PBM) .

Production	Consumption	Type of consumption	Allocation for production to *producer*	Allocation for consumption to *consumer*
Inside system boundary of PBM	Inside system boundary of PBM	Product BM	PBM	PBM
		Safety flare	PBM	n.a.[1]
		Flare	PBM, de facto none	n.a.[1]
	Outside system boundary of PBM	Measurable heat	PBM	Heat BM
		Non Measurable heat	PBM	Fuel BM
		Electricity	PBM	None
Production	**Consumption**	**Type of consumption**	**Allocation for production to *consumer***	**Allocation for consumption to *consumer***
Outside system boundary of PBM	Inside system boundary of PBM	Product BM	Formula page 9	Product BM
	Outside system boundary of PBM	Measurable heat	Formula page 9	Heat BM
		Non Measurable heat	Formula page 9	Fuel BM
		Safety flare	None	Fuel BM
		Flare	None	None
		Electricity	Formula page 9	None

[1] Flares and safety flares from waste gases produced within the system boundaries of a product benchmark, are already taken into account in determining the product benchmark

5   Case Studies

In this section, three case studies are presented:

Example 1:   The extensive example detailed in Guidance Document 2 is presented here with a focus on the treatment of waste gases: how to define the relevant sub-installations and what data are the key ones to take into account.

Example 2:   This second example shows how to calculate the allocation in the case of waste gases produced within the boundaries of a benchmarked product. The example of an iron and steel plant is given, which sells its waste gases to a third-party who used part of them to generate electricity, and part for heat production.

Example 3:   This third example shows how to calculate the allocation in the case of waste gases produced outside the boundaries of a benchmarked product. The example of a chemical plant is given, which uses part of its waste gases on site for electricity production, sells part of its waste gases to a third party for heat production, and flares the remainder.

5.1   Example 1 – defining sub-installations linked to waste gases

In this example plant, 3 products are produced:
- P2, which is a benchmarked product,
- P1 and P3 which are non-benchmarked products.

Each of these products consumes fuel and heat and produce waste gases (see Figure 5-1). The remainder of this section discusses

- Issue 1: waste gases produced in the production process of product P2
- Issue 2: waste gases produced in the production processes of products P1 and P3
- Issue 3: waste gases consumed within the installation to produce steam
- Issue 4: waste gases flared
- Issue 5: impact on the fuel benchmark sub-installation

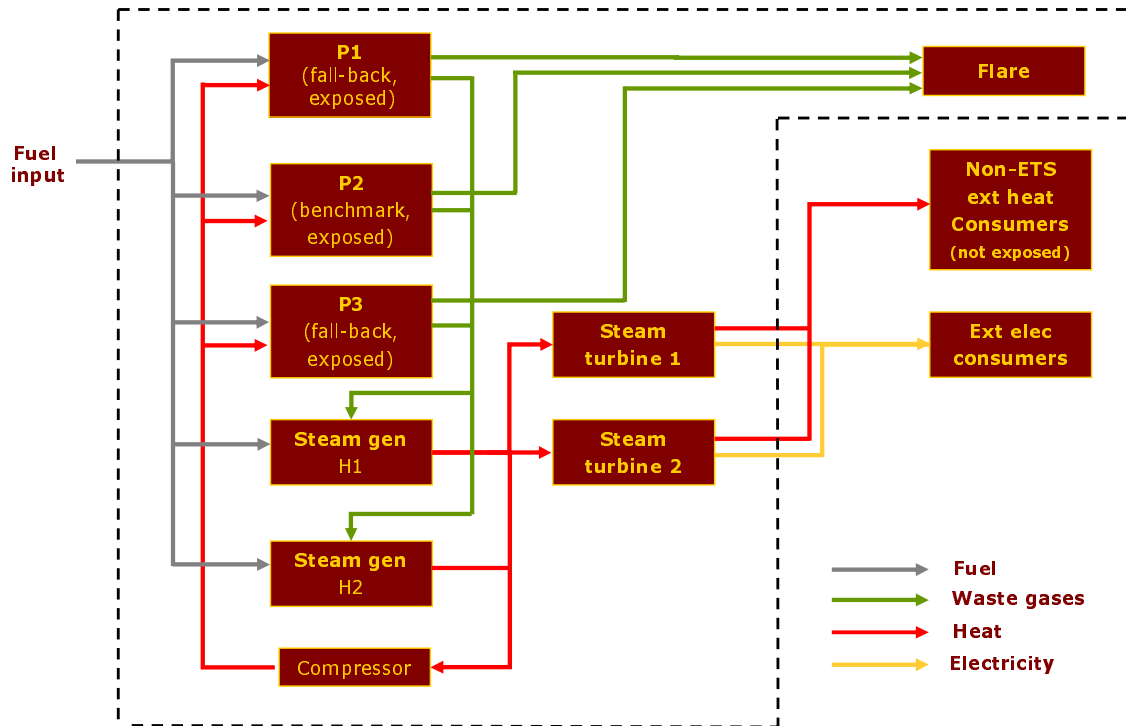For more information on other aspects of this example, see Guidance Document 2 on Allocation Methodologies.

Figure 5-1 Example 1 installation boundaries; Raw material flows are not shown (e.g. carbon used as reducing agent or chemical synthesis).

- *Issue 1: waste gases produced in process P2*

Product P2 is a benchmarked product. Therefore, allocation to the producer of waste gases is based on the product benchmark of P2 (see Figure 5-2). No data relating to the waste gas is needed, as the allocation will only be based on P2 production data. Allocation to the consumer of waste gases produced by process P2 are discussed as issues 3 and 4.
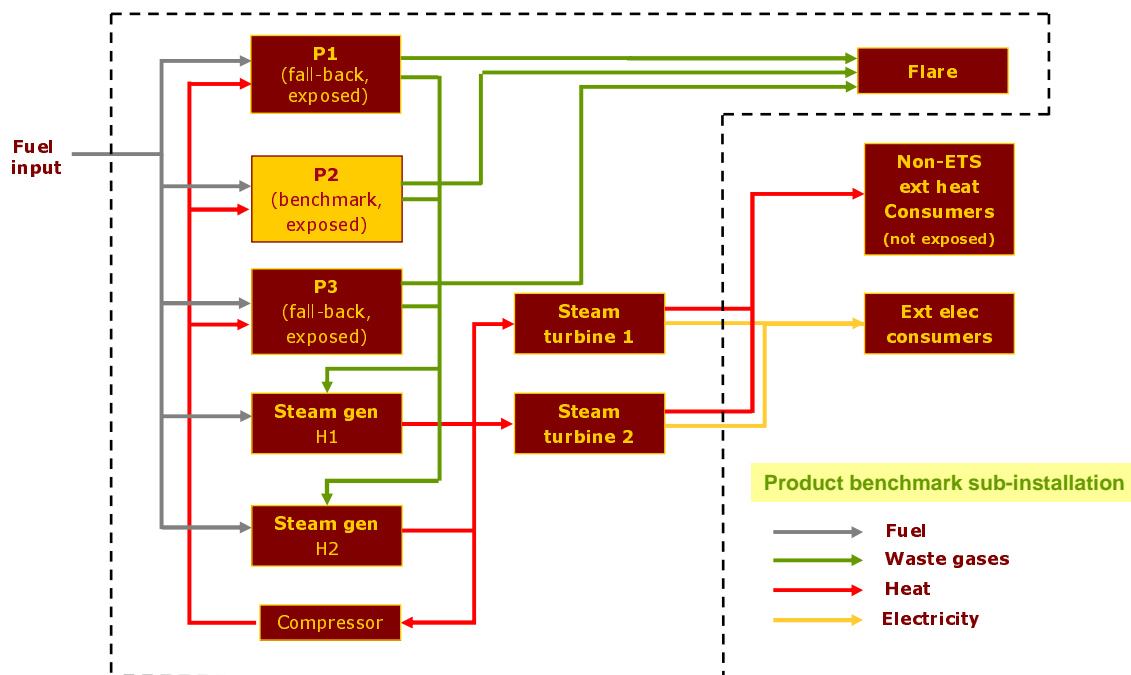
Figure 5-2   Example 1 – Waste gases produced by P2 (highlighted process) are included in the product benchmark P2; Raw material flows are not shown (e.g. carbon used as reducing agent or chemical synthesis).

- *Issue 2: waste gases produced in processes P1 and P3*

As P1 and P3 are not benchmarked products. Allocation to these processes is determined considering the production of these waste gases as process emissions, and is given to the consumer of these waste gases (steam gen H1 and H2; where the emissions occur). In this example, as the consumer is also the producer of the waste gas, this sub-installation will be part of this installation; if the waste gas had been sold to an ETS-installation, the latter would have received the allocation.

Waste gases from both P1 and P3 will be part of the same process emission sub-installation (see Figure 5-3). If additional and physically separate, process emissions were emitted within the boundaries of the installation, these would have been included in this sub-installation as well.

The allocation of this sub-installation will be:

$$Allocation = Reduction\ factor \times HAL$$

With

$$HAL = Median_{BaselinePeriod}\ [V_{WG}\ x\ NCV_{WG}\ x\ (EF_{WG}\text{-}EF_{NG}\ x\ Correction_\eta)]$$

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Where
Reduction factor	*0.97*
V_{WG}	*Non-flared volume of waste gas in Nm^3 or tonnes*
NCV_{WG}	*Net Calorific Value of the waste gas in TJ/Nm^3 or TJ/t*
EF_{WG}	*Emission factor of the waste gas in tCO_2/TJ*
EF_{NG}	*Emission factor of natural gas (= 56.1 tCO_2/TJ)*
$Correction_\eta$	*0.67*

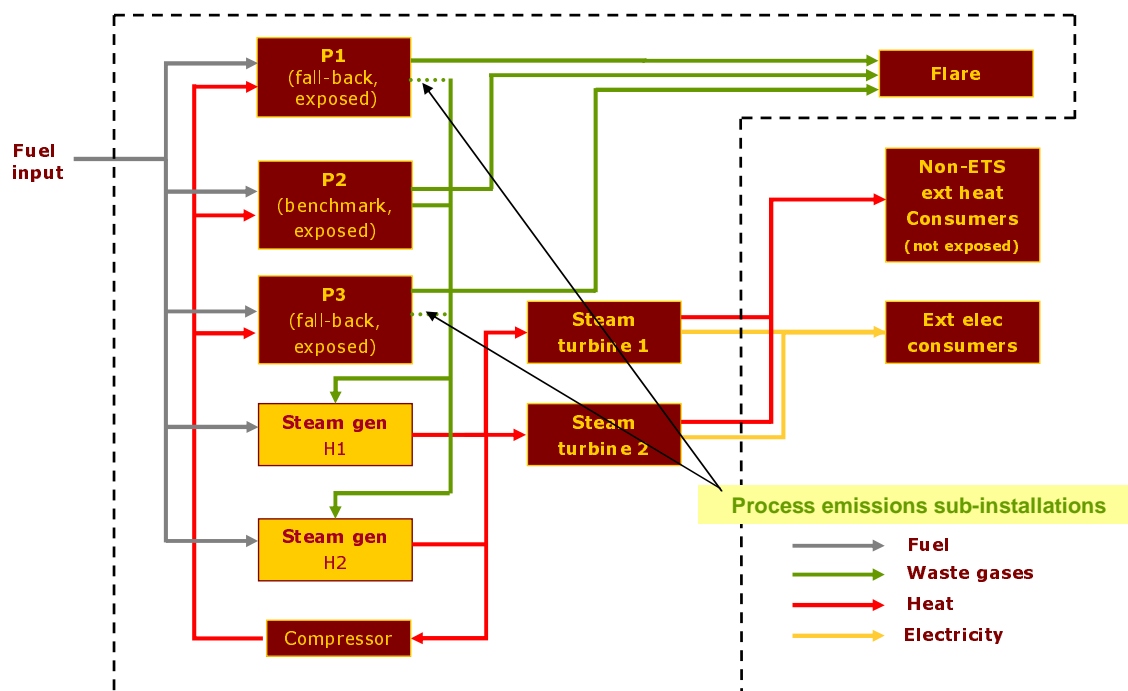Allocation to the consumer of waste gases produced by processes P1 and P3 are discussed as issues 3 and 4

Figure 5-3   Example 1 – Waste gases from non benchmarked products (P1 and P3) are included in a process emissions sub-installation. The allocation related to these process emissions goes to the waste gas consuming process (in this example: Steam gen H1 and H2 which are part of the same installation); Raw material flows are not shown (e.g. carbon used as reducing agent or chemical synthesis).

- **Issue 3: waste gases consumed within the installation to produce steam**

The emissions linked to the use of the waste gases to generate steam are covered by the heat sub-installations allocating allowances to the heat consumers on the basis of the heat benchmark. The data needed to calculate this allocation will be the median of the amount of heat consumed over the baseline period by the relevant heat consumers (heat consumed to produce P1 and P3 in the case of the sub-installation in Figure 5-4, and heat exported to external heat consumers in the case of Figure 5-5). These are split into 2 sub-installations to take into account the different carbon leakage status of each sub-installation (see Guidance Documents 2 on allocation methodologies and 5 on carbon leakage for more guidance on this).
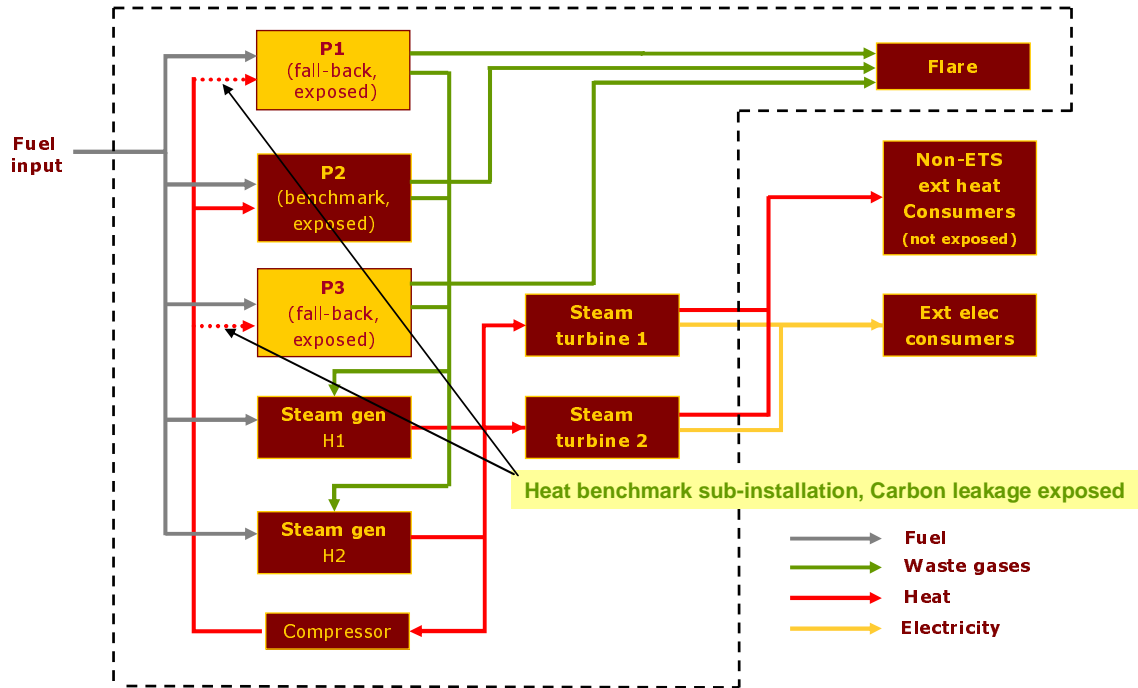
Figure 5-4 Example 1 – P1 and P2 receive allocation for consumed heat that was partially produced using waste gases; Raw material flows are not shown (e.g. carbon used as reducing agent or chemical synthesis).
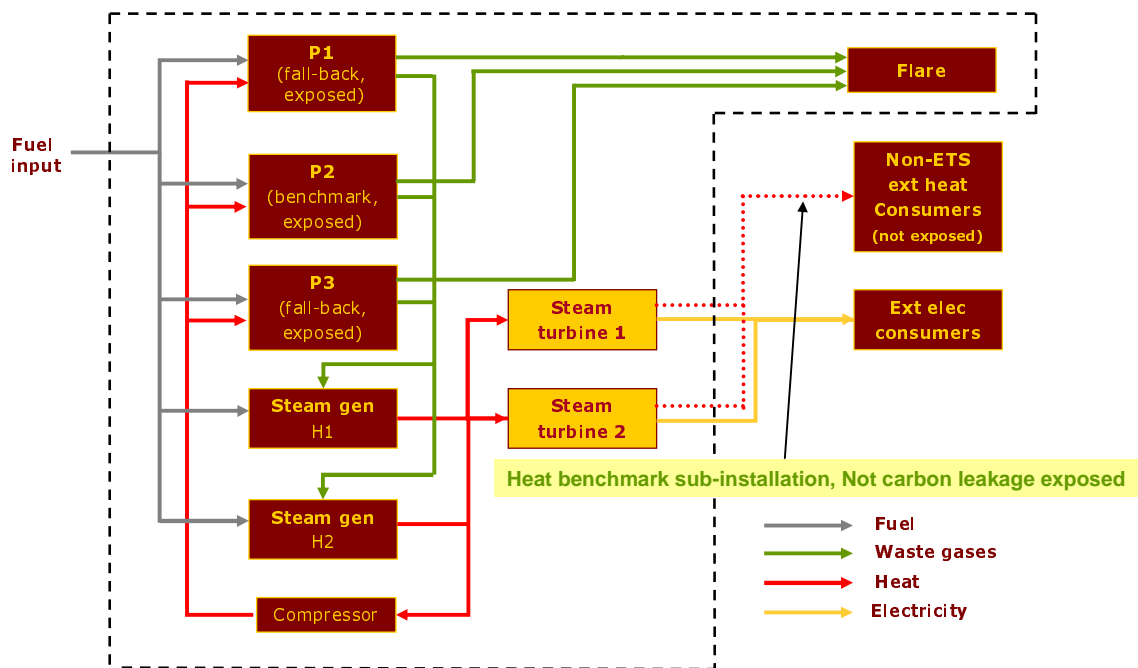

Figure 5-5 Example 1 – Steam turbines 1 and 2 receive allocation for the heat exported to external non-ETS heat consumers; The exported heat was partially produced using waste gases; Raw material flows are not shown (e.g. carbon used as reducing agent or chemical synthesis).

- **Issue 4: waste gases flared**

Emissions from the flaring of waste gases are not eligible for free allocation. Only if flaring meets the criteria for safety flaring (see section 2), will there be an allocation.

Safety flaring of waste gases produced by processes P1 and P3 will be included in the fuel sub-installation of the plant (see issue 5 here-after). Safety flaring of waste gases produced by P2 is already accounted for in the product benchmark for P2 and is not eligible for free allocation under a fuel benchmark.
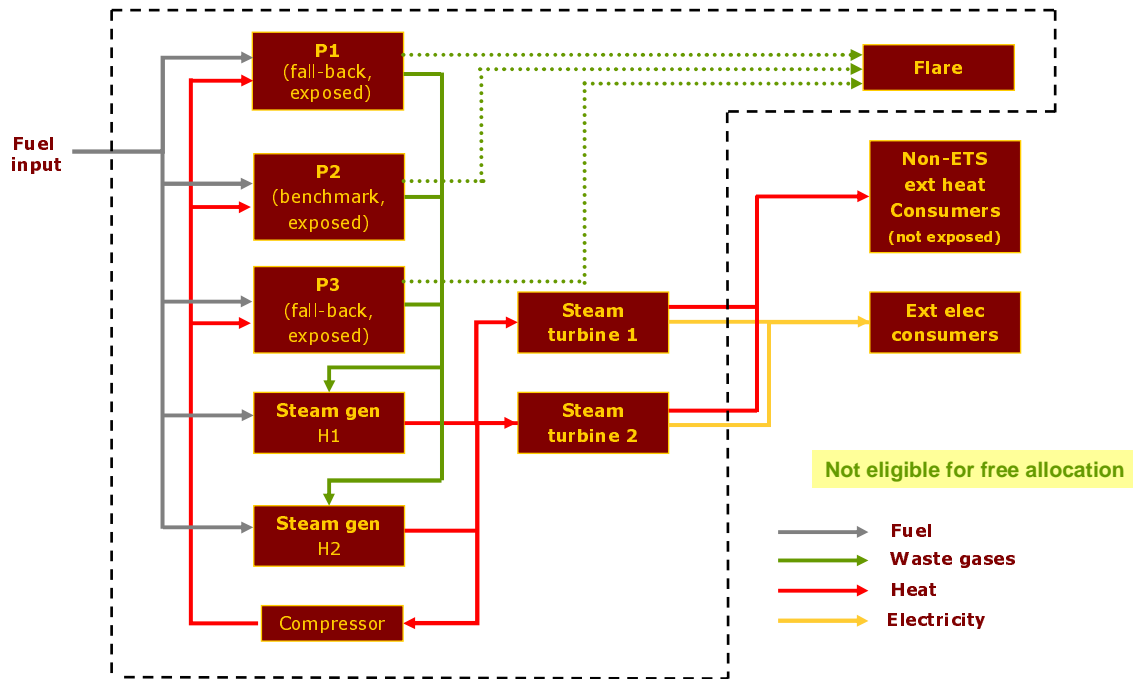

Figure 5-6   Example 1 – Flaring (except for safety flaring) is not eligible for free allocation.

- **Issue 5: impact on the fuel benchmark sub-installation**

If some fuels used to produce P1 and P3 are converted into waste gases, their amounts cannot be allocated to the fuel benchmark sub-installation (see Figure 5-7). Therefore, the allocation to the fuel sub-installation should be:

$$Allocation = BM_{fuel} \times HAL_{fuel}$$

With

HAL_{fuel} = $Median_{baseline}[Fuel_{Process} - V_{WG} \times NCV_{WG} \times \alpha + Fuel_{SafetyFlaring} + V_{WG} \times NCV_{WG} \times \beta]$

where
BM_{fuel} is 56.1 allowances/TJ
HAL_{fuel} is the Historical Activity Level of the fuel sub-installation
$Median_{Baseline}$ is the median value over the baseline period
$Fuel_{process}$ is the total amount of fuel consumed in production processes 1 and 3 excluding fuel used as reducing agent or chemical syntheses (expressed in TJ)

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V_{WG} is the total volume of waste gas exiting the production process(expressed in Nm^3 or tonnes)

NCV_{WG} is the Net Calorific Value of the waste gas (expressed in TJ/Nm3 or TJ/t)

$Fuel_{SafetyFlaring}$ is the total amount of fuel necessary for safety flaring; i.e. the fuels necessary to keep a pilot flame running and fuels required to successfully combusted the flared gas (expressed in TJ)

α is the share of waste gases originating from the fuel

β is the share of total waste gases that is flared in accordance with the definition of safety flaring
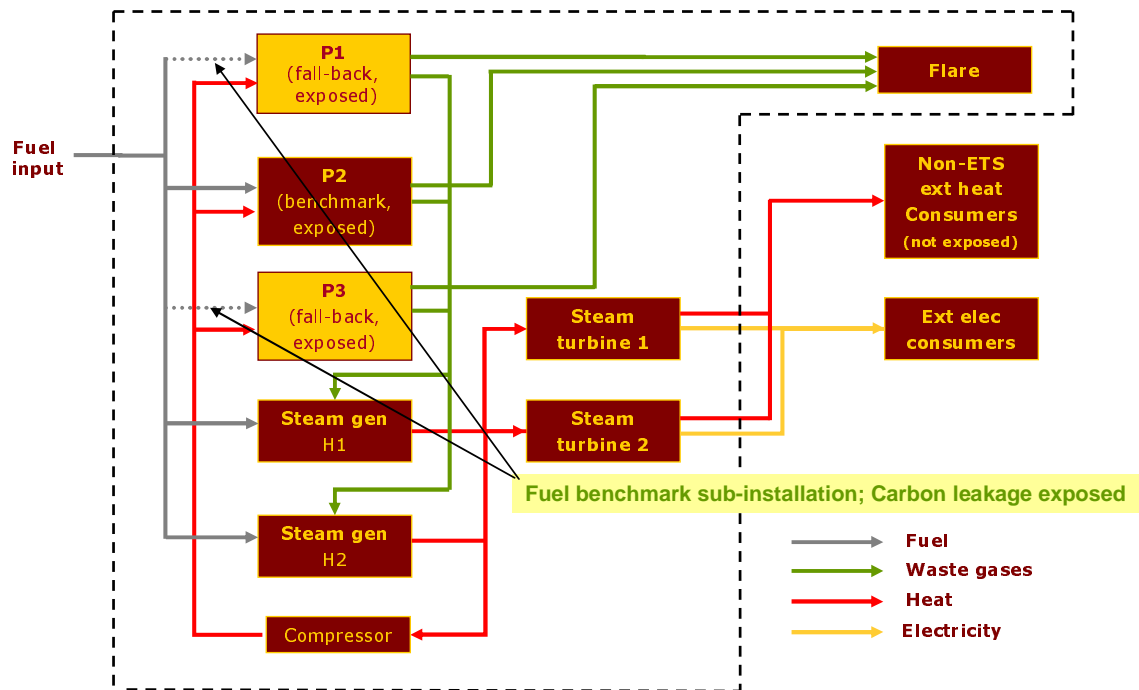
Figure 5-7   Example 1 – Fuel combusted in processes P1 and P2 is eligible for free allocation. This fuel benchmark sub-installation also includes any safety flaring of waste gases produced by P1 and P2, but excludes fuels that are converted into waste gases.

5.2 Example 2 – allocation in the case of a benchmarked product

In this example, an integrated steel plant:
- Uses part of its Blast Furnace Gas (BFG) for under-firing the stoves
- Sells the remaining BFG to
  - a power plant (covered by the ETS)
  - another plant covered by the ETS (plant A) using the BFG for heat production.
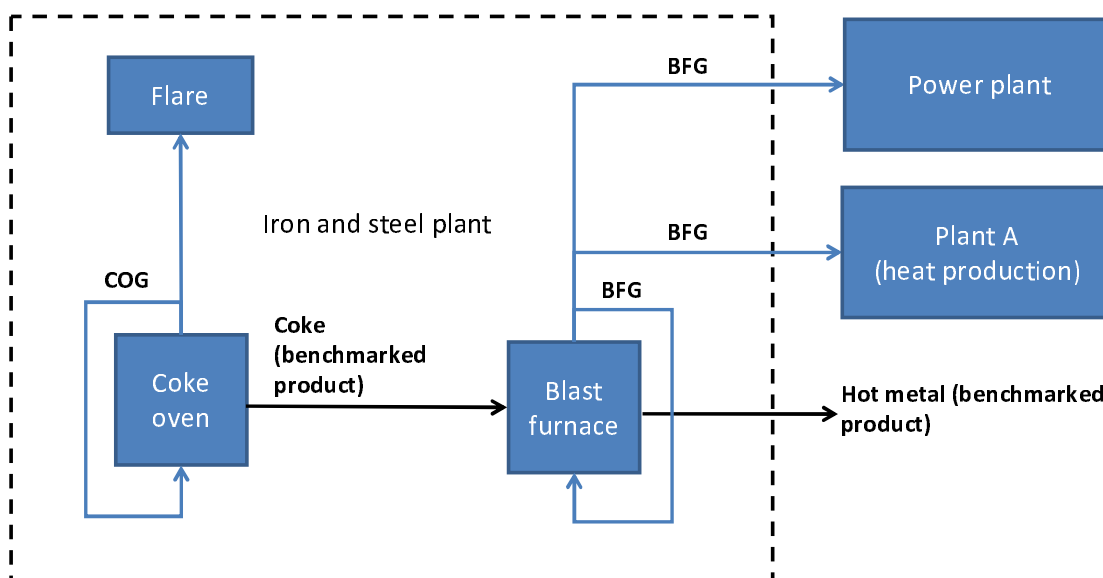- Uses its Coke Oven Gas (COG) for under-firing and flares the remaining amount (see Figure 5-8).

Figure 5-8   **Example 2 – Waste gases produced within a product benchmark**

The allocation to the steel plant will be the following, regardless of whether the waste gas is used for direct or indirect heating, or for electricity production, or is flared:

$$Allocation = BM_{hot\ metal} \times HAL_{hot\ metal} + BM_{coke} \times HAL_{coke}$$

Where:
$BM_{hot\ metal}$ is 1.328 allowances/t hot metal
$HAL_{hot\ metal}$ is the median production of hot metal over the baseline period
BM_{coke} is 0.286 allowances/t coke
HAL_{coke} is the median production of coke over the baseline period

The allocation to plant A relating to its heat consumption (including heat produced from the waste gases) will be the following, assuming that plant A produces heat for the production of non-benchmarked products or for export to non-ETS consumers:

$$Allocation = BM_{heat} \; x \; HAL_{heat}$$

Where
BM_{heat} is 62.3 allowances/TJ
HAL_{heat} is the median heat consumption of plant A over the baseline period expressed in TJ

There will be no free allocation for the power plant.

5.3   Example 3 – allocation in the case of a non-benchmarked product

In this example, a chemical plant not covered by a product benchmark:
- Uses part of its waste gases to produce electricity on-site
- Sells part of its waste gases to another plant (plant B) for heat production
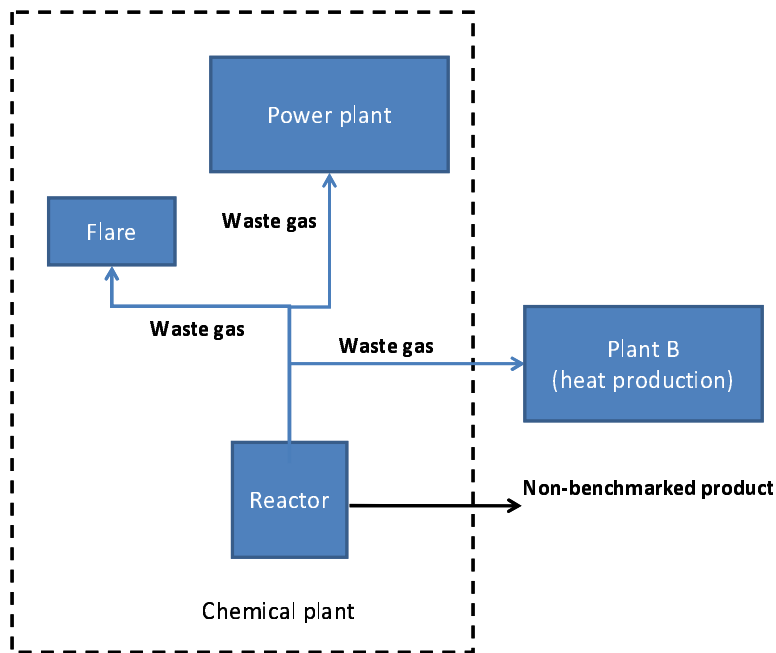- Flares the remaining waste gases

(see Figure 5-9).

Figure 5-9   **Example 3 – Waste gases produced outside the boundaries of a product benchmark**

Attention has to be paid in this case that the allocation for the production of the waste gas is to be split between the chemical plant (who uses its own waste gas) and the external user of the waste gas (plant B).

The allocation to the chemical plant relating to the waste gas production will be the following, taking into account all non-flared waste gas, regardless of whether it is used for direct or indirect heating, or for electricity production:

$$Allocation = 0.97 \times Median_{BaselinePeriod} [V_{WG,\ chem.\ plant} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Correction_{\eta})]$$

Where:

$V_{WG,\ chem.\ plant}$	*Non-flared volume of waste gas in Nm^3 or tonnes used internally in the chemical plant*
NCV_{WG}	*Net Calorific Value of the waste gas in TJ/Nm^3 or TJ/t*
EF_{WG}	*Emission factor of the waste gas in tCO_2/TJ*
EF_{NG}	*Emission factor of natural gas (= 56.1 tCO_2/TJ)*
$Correction_{\eta}$	*A factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel natural gas*

The chemical plant will get no free allocation for the use of waste gases for electricity production, nor any allocation for the flared waste gases, except if they are flared for safety reasons. In case of safety flaring, an additional allocation will be given to the chemical plant, which will be included in its fuel benchmark sub-installation *(not presented here)*.

The allocation to the plant B (external waste gas consumer) relating to the waste gas production will be the following, taking into account all non-flared waste gas, regardless of whether it is used for direct or indirect heating, or for electricity production:

$$Allocation = 0.97 \times Median_{BaselinePeriod} [V_{WG,\ plant\ B} \times NCV_{WG} \times (EF_{WG} - EF_{NG} \times Correction_{\eta})]$$

Where:

$V_{WG,\ plant\ B}$	*Non-flared volume of waste gas in Nm^3 or tonnes used in plant B*
NCV_{WG}	*Net Calorific Value of the waste gas in TJ/Nm^3 or TJ/t*
EF_{WG}	*Emission factor of the waste gas in tCO_2/TJ*
EF_{NG}	*Emission factor of natural gas (= 56.1 tCO_2/TJ)*
$Correction_{\eta}$	*is a factor that accounts for the difference in efficiencies between the use of waste gas and the use of the reference fuel natural gas*

In addition to this part of the allocation for the <u>production</u> of the waste gas, plant B will also get allocation for the heat produced based on the waste gases (and possibly other fuels, not presented in the figure). The allocation to plant B relating to its heat consumption (including heat produced from the waste gases) will be the following:

$$Allocation = BM_{heat} \times HAL_{heat}$$

Where

BM_{heat}	*is 62.3 allowances/TJ*
HAL_{heat}	*is the median heat consumption of plant A over the baseline period*